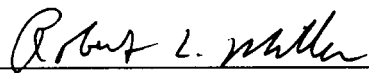


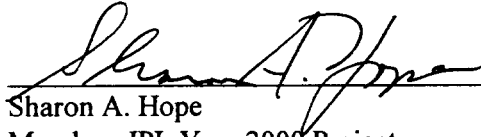
JPL Year 2000 Compliance Requirements

24 July 1998

Prepared by:

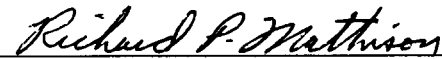


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1. Introduction

1.1 Identification

The JPL Year 2000 Compliance Requirements herein apply to all JPL systems that will be in service beyond fiscal year 1998. The JPL Year 2000 Compliance Requirements apply to all operational modes and states of each JPL system and its components. Verified compliance with these requirements will help to mitigate the risks specifically associated with the year 2000 and other high risk dates.

1.2 Compliance Definition

Year 2000 compliant means the correct processing of date and time data (including calculations, comparisons, and sequences) from 1998 through 2015 including leap years.

The requirements specified herein interpret this definition for JPL systems. Each requirement applies to each JPL assembly and subsystem, unless the requirement is non-applicable because the functionality addressed by the requirement does not exist in that assembly or subsystem. Any JPL system or component satisfying all the applicable requirements listed in this document will be designated "Year 2000 compliant".

1.3 Document Scope

The year 2000 compliance requirements herein apply to all JPL organizations.

These requirements apply to a software, firmware, or information-processing hardware item if:

- The item is part of any JPL product or service that the organization delivers to other organizations that are either external or internal to JPL.
- The item is used to develop or support any JPL product or service that the organization delivers to other organizations that are either external or internal to JPL.
- The item is used to support the development or operation of another year 2000 inventoried item.
- The function of the hardware item is dependent upon embedded information processing elements.

NOTE: The JPL Year 2000 Project will survey commercial off the shelf (COTS) products to determine their compliance status and publish it through <http://tmody2k>. This service is meant to support, not supplant, Y2K compliance certification of JPL subsystems. Appropriate cognizant

individuals or groups are still expected to determine the compliance of components under their cognizance.

WARNING

Time-shift testing should only be performed on systems that are isolated from both development and operations. Before beginning such testing, the system should be completely backed up to external media; procedures should have been previously tested and documented that describe how to back up the data, change the dates at all layers of the system architecture, and restore the data. After completion of time-shift testing, the media must be erased and all back-up files restored. Failure to do so risks the creation of anomalies arising from files and operating system services having dates in a future year.

Remember: 2000 is a Leap Year

1.4 Notation

19nn is used to indicate a non-specific date within the range of 1900 through 1999.

20nn is used to indicate a non-specific date within the range of 2000 through 2099.

Time-shift is the term used herein to indicate the changes in system date and time necessary for year 2000 testing. The isolated test platform must be set to the future date and time for the test, then restored and set to the actual current date and time.

Y2Knnn enclosed in braces is the object identifier for the requirement (guaranteed unique and permanent). Use these for future requirement references. (Do not use paragraph numbers, as they may change in the future as the requirements evolve.)

1.5 Controlling Documents

JPL Year 2000 Project Policy, Year 2000 Inventory Requirements, June 1, 1998.

JPL Year 2000 Project Policy, Year 2000 Compliance Certification, TBD.

D-14547-1 JPL Year 2000 (Y2K) Implementation Integration Project Plan, 20 February 1998.

D-TBD JPL Year 2000 Certification Process.

1.6 Applicable Documents

1.6.1 Additional Requirements

NASA Procurement Information Circulars 98-8 and 98-9:

Year 2000 Compliance, Solicitations and New Contracts, May 21, 1998.
<http://www.hq.nasa.gov/office/procurement/regs/pic98-8.html>

Year 2000 Compliance, Existing NASA Contracts, May 21, 1998.
<http://www.hq.nasa.gov/office/procurement/regs/pic98-9.html>

1.6.2 Reference or Explanatory Documents

JPL Year 2000 Web Page, URL: <http://newproducts.jpl.nasa.gov/forms/jplyr2k1.htm>

GAO/AIMD-10.1.14 Year 2000 Computing Crisis: An Assessment Guide, September 1997.

TMOD Year 2000 Code Inspection Procedures, February 10, 1998. URL: <http://tmody2k>

1.7 Priorities and Risk-Based Testing Approach

Due to the need for uninterrupted JPL services through the year 2000 and beyond, validation of Y2K capabilities is required for all items which fall under the scope of this document, as defined in Section 1.3. The Y2K testing approach is based on demonstrating that existing functionality will operate normally on general days in 2000, and that rollovers for the dates specified in Table 2-1 do not generate anomalous behavior. The most cost-effective order for conducting Y2K testing is to first validate the operation for general days in 2000 and then to conduct specific rollover tests according to the level of risk (Section 1.8) and available resources. Testing is to be conducted in accordance with standard development practices that culminate in system acceptance testing and end-to-end testing.

Thus, validation is divided into two sequential activities:

1. First priority is assigned to validating only the requirements that deal with the ability to sustain normal operations on a day after 1 January 2000. This test includes the verification of the year 2000 requirements herein, and the verification of the functional requirements specific to the item under test in the year 2000 environment.
2. Second priority is assigned to the requirements in paragraph 2.2.2. These requirements deal with specific dates which are discussed in the literature as potential sources of Year 2000 problems, and identified herein as "high risk dates." The need to validate Y2K compliance for a particular date is based on each system's risk level as defined next.

1.8 Risk Levels

High Risk System

The system is classified as high risk if it meets any one of the following three criteria:

- Safety or human life is jeopardized by long or short term disruption of the service or product.
- Unscheduled disruptions in the service or product cannot be tolerated.
- Unscheduled disruption of service will put NASA at a disadvantage.

Medium Risk System

The system is classified as medium risk if it meets both of the following criteria:

- Unscheduled disruptions for more than one hour will put NASA at a disadvantage.
- Unscheduled disruptions of one hour or less in the service or product can be tolerated.

Low Risk System

The system is classified as low risk if it meets either of the following criteria:

- Unscheduled disruption in the service or product for 25 hours can be tolerated.
- Alternative means can provide a minimum-level of the same service or product.

High Risk Date

A date is termed high risk if it is known to be associated with date-triggered, or year 2000 failures. These conditions involve the following:

- Transition to 2000.
- Leap year-specific.
- Association with an overflow condition.
- Dates used historically as a flag to trigger special-case processing that is not date related.

2. JPL Year 2000 Compliance Requirements

Year 2000 Compliance Requirements for all JPL software and firmware are presented in the following paragraphs.

2.1 Compliance Verification Method

Compliance with these requirements shall be verified by inspection, analysis, and test. Items that are not date affected, as verified by inspection and analysis and approved by the JPL Year 2000 Project Manager, do not require testing. All certifications of Year 2000 compliance require approval by the JPL Year 2000 Project Manager. Reference the D-TBD *JPL Year 2000 Certification Process*. {Y2K22}.

Acceptance testing shall not begin until the source code has passed an inspection using the Year 2000 DSN Code inspection tool (YDC) or an equivalent tool, and the operating system and other supporting COTS items have been evaluated for compliance. The results shall be documented in a Y2K inspection report and made available before entering Year 2000 testing. {Y2K123}

2.2 *General Integrity*

No value for "Current Date" shall cause interruptions in normal operation. {Y2K23}

This requirement shall include, but not be limited to, the following:

- 1) Monitor Data. {Y2K26}
- 2) Commands and Responses. {Y2K27}
- 3) User input. {Y2K28}
- 4) Support Data. {Y2K29}
- 5) Displays. {Y2K30}
- 6) Alarms. {Y2K31}
- 7) Alerts. {Y2K32}
- 8) Logs. {Y2K33}
- 9) Other applicable input or output data. {Y2K34}
- 10) Backups and restoration: archival, routine, and incremental. {Y2K35}
- 11) No value for "Current Date" on any clock or timing mechanism within any JPL system, subsystem, or assembly shall cause interruptions in normal operation. Examples of time sources are:
 - a) Host system clock time.
 - b) Operating system clock time.
 - c) Application time.
 - d) Time code translator (TCT) Time (i.e., part of the Deep Space Communications Complex Frequency & Timing Subsystem (DSCC FTS).
 - e) Network clock time (e.g., Network Time Protocol (NTP).
 - f) Distributed environment clock time (e.g., Distributed Computing Environment (DCE).
 - g) Master clock time.
 - h) Slave clock time.
 - i) Simulated Time (e.g., SIM time).
 - j) Other applicable internal or external time sources.
 - k) Timers. {Y2K36}

2.2.1 *Resolve Dates with Two-Digit Year Fields*

All JPL systems, subsystems, and assemblies shall correctly resolve dates with two-digit year fields by selecting a window boundary that is appropriate for both the range of data that must be resolved

and the interpretation of the underlying operating system. (For example, the Open Group has adopted the following specification for UNIX: two-digit years in the range 69 - 99 refer to the 20th century (19nn), and values in the range 00 - 68 refer to the 21st century (20nn).) {Y2K25}

Interface agreements shall be written and approved whenever two-digit year representations are used. Existing interface agreements that use two-digit year representations shall be modified to specify the corresponding window boundaries. {Y2K124}

Each JPL system, subsystem, or assembly that resolves two-digit dates per Y2K25 shall verify that the window boundary does not lead to incorrect processing. (Example: A system using the 68/69 window would incorrectly process records containing year data values before 1969 if they were represented using only two digits.) {Y2K120}

Whenever two-digit date representations are used with different window boundaries for the application, operating system, or any component COTS software items, then each of the window boundaries shall be specified in the delivery documents, and Year 2000 compliance testing shall include tests of the different boundary conditions to verify that all required dates are correctly resolved. {Y2K 125}

2.2.2 High Risk Dates

Each JPL system, subsystem, and assembly shall operate without corruption or interruption to normal functionality through the high risk date rollovers listed in Table 2-1. The system risk level, as defined in Section 1.8, determines the number of high risk dates that must be verified:

Table 2-1 High Risk Date Requirements, With Risk-Based Testing Guidance			
High Risk Date Requirement	Low Risk System	Medium Risk System	High Risk System
1) 31 December 1998 (day 365) to 1 January 1999 (day 001; flag year 99; Thursday to Friday). {Y2K40}	Required	Required	Required
2) 8 April 1999 to 9 April 1999 (day 99, flag year 99; Thursday to Friday). {Y2K126}	Optional (Required if Business System)	Optional (Required if Business System)	Optional (Required if Business System)
3) 8 September 1999 to 9 September 1999 (9999 flag date; Wednesday to Thursday). {Y2K41}	Optional (Required if Business System)	Required	Required
4) 31 December 1999 to 1 January 2000 (overflow 2-digit years; Friday to Saturday. Note: 01/01/1900 was a Monday). {Y2K42}	Required	Required	Required
5) 1 January 2000 to 2 January 2000 (Saturday to Sunday. Note: 01/02/1999 was a Tuesday) . {Y2K127}	Optional	Optional	Optional
6) 9 January 2000 to 10 January 2000 (first 9-character date). {Y2K44}	Optional	Optional	Optional (Required if Business System)
7) 28 February 2000 to 29 February 2000 (leap year; Monday to Tuesday). {Y2K45}	Required	Required	Required
8) 29 February 2000 to 1 March 2000 (leap year; Tuesday to Wednesday). {Y2K46}	Optional	Optional	Required
9) 9 October 2000 to 10 October 2000 (first 10-character date; Monday to Tuesday). {Y2K48}	Optional	Optional	Optional (Required if Business System)
10) 30 December 2000 (day 365) to 31 December 2000 (day 366; leap year; Saturday to Sunday). {Y2K49}	Required	Required	Required
11) 31 December 2000 (day 366) to 1 January 2001 (day 001; leap year; Sunday to Monday). {Y2K50}	Optional	Required	Required
12) 28 February 2001 to 1 March 2001 (not a leap year; Wednesday to Thursday). {Y2K52}	Optional	Optional	Optional
13) 31 December 2001 (day 365) to 1 January 2002 (day 001; not a leap year; Monday to Tuesday). {Y2K54}	Optional	Optional	Optional
14) 28 February 2004 to 29 February 2004 (leap year; Saturday to Sunday) {Y2K128}	Optional	Optional	Optional
15) 29 February 2004 to 1 March 2004 (leap year; Sunday to Monday) {Y2K129}	Optional	Optional	Optional
16) 30 December 2004 (day 365) to 31 December 2004 (day 366; leap year). {Y2K56}	Optional	Optional	Optional
17) 31 December 2004 (day 366) to 1 January 2005 (day 001; leap year). {Y2K57}	Optional	Optional	Optional
18) Critical Business Dates, Cycles or Periods. The first	Required	Required	Required

Table 2-1 High Risk Date Requirements, With Risk-Based Testing Guidance			
High Risk Date Requirement	Low Risk System	Medium Risk System	High Risk System
instance of every recurring cycle shall be tested. (These are system dependent, e.g., Calendar or Fiscal End of Month, Quarter, Year, Pay Period.) {Y2K121}			

Hardware component system dates shall roll over correctly on the high risk dates corresponding to Y2K42, Y2K45, and Y2K49 in the following states:

- a) Powered-up state. {Y2K64}
- b) Powered-down state. {Y2K65}

2.2.3 Timeouts, Delays, and Sleep Functions

All timeouts, delays, and sleep functions of software and firmware shall function as documented in the applicable functional specification. {Y2K115}

2.2.4 No Special Interpretation for Date Field Allowed

Software or firmware code shall not reserve a date field for special interpretation. {Y2K59}

Examples:

- 1) Flag year 99 as something other than year significance.
- 2) Flag year 00 as something other than year significance.
- 3) Flag Julian (DOY) date 99.365 as other than year significance.

2.2.5 Reinitialize Normally

Each JPL system, subsystem, and assembly shall reinitialize normally during a:

- 1) Warm Start. {Y2K61}
- 2) Cold Start. {Y2K62}
- 3) Failover to redundant system. {Y2K117}

2.2.6 Handle Non-Compliant Input

Each JPL system, subsystem, and assembly shall operate without corruption or interruption to normal functionality when it processes or interprets data from a non-compliant entity with invalid

date fields, and the invalid data shall trigger an alarm. (Note: Pass-through data are excluded from the need to alarm per Y2K84.) {Y2K66}

(Explanatory note: A compliant system should not crash if it receives incorrect date data from an external non-compliant system.)

2.2.7 Dates on Generated Labels

Software and firmware generated storage media labels shall display the correct date with no ambiguity. {Y2K67}

2.2.8 Dates on Hardcopy Reports

Hardcopy reports shall display the correct date with no ambiguity. {Y2K68}

2.3 Date Integrity

2.3.1 Date Manipulation and Leap Year

Manipulations and computations of calendar-related data (date, duration, day of week, day of year, date comparison, day within week, week within year, etc.) within each JPL system, subsystem, and assembly shall produce desired results for all valid date values. {Y2K70}

Reminder: Between 1998 and 2015, 2000, 2004, 2008, and 2012 are leap years.

2.3.2 Dates from Both Centuries

Each JPL system, subsystem, and assembly shall correctly handle dates from both centuries concurrently for:

- 1) Timers. {Y2K72}
- 2) Data/file/user/password/permission expirations. {Y2K73}
- 3) Data retention periods. {Y2K74}

2.3.3 Dates in Data Storage

Each JPL system, subsystem, and assembly shall correctly use year in data storage, including use in databases and spreadsheets, such as when:

- 1) Storing and retrieving. {Y2K76}
- 2) Sorting and merging. {Y2K77}
- 3) Searching. {Y2K78}
- 4) Indexing on disk file or database table. {Y2K79}

5) Construction and use of schemas, queries, date value expressions, and date value functions shall be correct and unambiguous for century, year, month, and day. {Y2K118}

6) The value of dates stored in spreadsheets or databases shall be unaffected by changes to spreadsheet or database application software, version or platform. (This may involve procedural insertion of notation describing correct ranges for date fields as a workaround to compensate for different spreadsheet versions using different base or epoch dates.) {Y2K119}

2.3.4 *Date Conversion*

Each JPL system, subsystem, and assembly shall correctly convert between date representations when conversion is required. {Y2K81}

2.3.5 *Dates within Archival Data*

Each JPL system, subsystem, and assembly, when required to accept archival, time-delayed, previously captured, or playback data, shall preserve the integrity of the dates within the data. {Y2K83}

2.3.6 *Pass-Through Data*

Each JPL system, subsystem, and assembly shall not revise or correct dates in data from other subsystems for pass-through data. {Y2K84}

2.4 *Performance Requirements*

Each JPL system, subsystem, and assembly shall continue to meet its performance requirements. Changes made for JPL year 2000 compliance shall not adversely affect performance. {Y2K87}

2.5 *Reliability, Maintainability, and Related Requirements*

Changes made for JPL Year 2000 compliance shall not adversely affect the reliability, maintainability, availability, portability, security, or safety of any JPL system, subsystem, or assembly.

3. Reviews and Management Planning Requirements

The Y2K requirements for reviews and planning are described next.

3.1 Reviews

All reviews (e.g., PDCR, PDR, CDR) shall specifically address plans for meeting the Y2K milestone dates set by NASA. {Y2K90}

A test readiness review shall be conducted prior to year 2000 testing, if any of the following criteria are met:

- 1) Testing will be conducted on a shared platform or testbed.
- 2) Testing will be conducted on operational or development equipment.
- 3) The item to be tested is a component of a larger system that will also be tested for year 2000 compliance.
- 4) The item to be tested is a system test that contains components.
- 5) The item to be tested provides support to a service. {Y2K130}

3.2 Management Plans

Year 2000 compliance activities shall be specifically addressed in each management plan for any item falling under the scope of these requirements. {Y2K95}

Management plans for high risk systems shall include contingency plans. {Y2K122}

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4. Acceptance Criteria and Qualification Methods

The Y2K compliance process is an extension to the standard practices employed within JPL.

4.1 Acceptance Criteria

The acceptance criteria are that each JPL system, subsystem, and assembly shall meet the JPL year 2000 compliance requirements herein, and demonstrate compliance via a test report in accordance with the JPL Year 2000 Test Requirements Document. A test requirements trace matrix shall be included in the test reports. In the case of an item that is not date affected, the analysis and inspection reports shall be submitted to the JPL Year 2000 Project Manager for approval.

{ Y2K111 }

4.2 Isolated Testbed

All phases of year 2000 compliance testing shall be conducted on an isolated testbed which shall be restored after every cycle of date testing to ensure that the test was conducted using an uncorrupted operating system and environment. When verification of year 2000 compliance requires testing at an operational facility, the tests shall be coordinated with the responsible operations organization, and the environment shall be restored after every cycle of date testing. { Y2K112 }

4.3 Regression Testing

Regression testing shall be conducted to verify that the overall functionality of the JPL system, subsystem, or assembly has not been degraded. { Y2K113 }

4.4 Delivery Documents for Year 2000 Test Readiness

JPL system, subsystem, and assembly delivery documents shall contain a Y2K compliance assessment that records the following for each component (including hardware):

- 1) Statement of COTS products compliance.
- 2) Code inspection report.
- 3.) Approval by JPL Project Manager of items that are categorized as not date-affected.
- 4) Statement concerning the validity of software licenses through the year 2002. { Y2K116 }

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Appendix A Acronyms and Glossary

Business Cycle Date	Recurring dates, e.g., payday, month end, year end, quarterly reporting
Business System	Data processing systems, e.g., payroll, human resources, financial tracking, and those written using COBOL.
COTS	Commercial-Off-The-Shelf
DOY	Day of Year
Epoch Date	Date from which a particular application software or operating system begins counting time units. These units are then translated to calendar dates. Year 2000 category problems can occur if the translation algorithms are incorrect, or if the date from which the counter starts is changed by a version update. Different operating systems use different epoch dates. In some COTS spreadsheet applications, different versions of the same product use different epoch dates.
GOTS	Government-developed-Off-The-Shelf
High Risk Dates	Dates specifically associated with Y2K related problems. These include the transition to 2000, leap year-specific dates, dates associated with an overflow condition, dates associated with special processing, and dates that historically been used as a flag to trigger processing other than date-related (e.g., If date = 9/9/999 then stop processing).
High Risk System	The system is classified as high risk if it meets any one of the following three criteria: <ul style="list-style-type: none">- Safety or human life is jeopardized by long or short term disruption of the service or product.- Unscheduled disruptions in the service or product cannot be tolerated.- Unscheduled disruption of service will put NASA at a disadvantage.
Low Risk System	The system is classified as low risk if it meets either one of the following criteria: <ul style="list-style-type: none">- Unscheduled disruption in the service or product for 25 hours can be tolerated.- Alternative means can provide a minimum-level of the same service or product.
Medium Risk System	The system is classified as medium risk if it meets both of the following criteria: <ul style="list-style-type: none">- Unscheduled disruptions for more than one hour will put NASA at a disadvantage.- Unscheduled disruptions in the service or product for one hour or less can be tolerated.
Time-shift Testing	Testing for year 2000 compliance requires that the date and time on the system be set ahead to a future date. "Time-shift" is the term used herein to indicate this change in the system time and date from the actual time to a future time. Time-shift testing should only be performed on systems that are isolated from both development and operations. Before beginning such testing, the system should be completely backed up to external media; procedures should have been previously tested and documented that describe how to back up the data, change the dates at all layers of the system architecture, and restore the data. After completion of time-shift testing, the media must be erased and all back-up files restored. Failure to do so risks the creation of anomalies arising from files and operating system services having dates in a future year.